

REMARKS

Claims 1-10 and 12-20 are pending in the present application.

The Office Action at paragraph 4 took issue with the definition of "cryogenic stream" as used in claim 1, and therefore required correction. Accordingly, claim 1 has been rejected under 35 USC §112, 2d paragraph.

Claims 1-2, 4-9, 12-13 and 15-16 have been rejected under 35 USC §102(b) as being anticipated by U.S. 5,931,721 to Rose et al. ("Rose").

Claims 8-9 have been rejected under 35 USC §103(a) as being unpatentable over Rose.

Claim 10 has been rejected under 35 USC §103(a) as being unpatentable over Rose as applied to claim 1, and further in view of U.S. 2003/0010356 to Kuyel.

Claims 1, 3, 6-9 and 17-20 have been rejected under 35 USC §103(a) as being unpatentable over U.S. 6,333,268 to Starov et al., and in view of Rose.

Claim 10 has been rejected under 35 USC §103(a) as being unpatentable over Starov and Rose as applied to claim 1, and further in view of Kuyel.

Claims 1, 3-4, 8-9 and 12-15 have been rejected under 35 USC §103(a) as being unpatentable over U.S. 2002/0062840 to Verhaverbeke et al., and in view of Rose.

Claim 19 has been rejected under 35 USC §103(a) as being unpatentable over Verhaverbeke and Rose as applied to claim 1, and further in view of Kuyel.

Claim 14 is canceled by this amendment. The subject matter of canceled claim 14 is now included in amended claim 1. Accordingly, the rejection of claim 14 in the Office Action is now moot and need not be addressed in these remarks.

The amendments to claim 18 are to include the proper article with respect to claim elements and to provide for better reading of said claim. Entry of same respectfully is requested.

Applicants respectfully request reconsideration of the claims currently pending in view of the amendments above and the remarks which follow.

The following remarks are presented to address the issues raised at paragraphs 4-6 of the Office Action, pertaining to claim 1. Claim 1 has been amended to include, among other amendments, a clarification of the "cryogenic stream" of said claim. Support for such amendment can be found in the specification as originally filed at for example page 9, lines 15-16, page 11, lines 15-16 and page 12, lines 4-11. Therefore, it respectfully is submitted that the issue regarding the cryogenic stream and the rejection under 35 USC §112 have been addressed. Accordingly, the rejection under 35 USC §112 should be withdrawn.

The following remarks are presented to address the rejection of the claims under 35 USC §102(b) as being anticipated by Rose (Office Action, paragraph 8). Independent claim 1 has been amended to include:

"wherein the liquid is applied for remaining on the substrate surface in a layer of at least 5 angstroms for less than 10 minutes and preferably less than 2 minutes to evaporate and any condensation from the reactive gas and the vapor is provided as a liquid film on the substrate surface to reduce adhesion of the contaminants and evaporate prior to the cleaning

with the cryogenic stream” (hereinafter for the sake of brevity referred to as the “claim 1 element”).

Use of the fluid recited in clause (a) of claim 1 and the claim 1 element reduces the force of adhesion between the particulate matter and the substrate surface. The liquid layer (which has a high vapor pressure) and liquid film of the claim 1 element are to evaporate prior to the cryogenic cleaning, clause (b). If the liquid and film are too thick at the substrate surface they will not evaporate before cryogenic cleaning and accordingly, the liquid and film will crystallize during the cryogenic cleaning and cause the contaminant to re-adhere to the substrate surface, thereby undoing that which clause (a) of claim 1 had accomplished. The liquid layer and the film in clause (a) are to reduce the force of adhesion between the contaminants and the substrate surface by reducing the Hamaker constant and hence the Van der Waals force. Similarly, the liquid is at a prescribed layer on the substrate surface so that it does not take too long to evaporate as such would unnecessarily delay the cryogenic cleaning step. Any condensation from the reactive gas and vapor will evaporate. Support for the claim 1 amendment can be found in the specification at for example page 6, line 32 to page 7, line 5, page 7, lines 2-5, page 8, lines 24-26 (wherein references to reactive gas may include reactive vapors and vice versa), page 9, lines 4-5 and 24-26 and page 10, line 13. Entry of the amendments to claim 1 respectfully is requested.

In order for a claim to be anticipated by a reference and therefore unpatentable under 35 USC §102(b), the reference cited must disclose each and every element of the claimed invention.

Rose is cited in the Office Action to reject independent claim 1 under 35 USC §102(b). By this amendment, claim 1 has been amended and as such is not anticipated by Rose. Nowhere in Rose is there disclosed the claim 1 element as

called for in amended independent claim 1. Accordingly, Rose does not anticipate amended claim 1, or any of the claims which depend therefrom. Therefore, the rejection of claim 1 as amended and the claims dependent therefrom under 35 USC §102(b) in view of Rose should be withdrawn.

The following remarks are presented to address the rejection of claims under 35 USC §103(a) as set forth in the Office Action at page 6, paragraph 13.

Starov discloses removing post-etch residues and other adherent matrices by exposing same to vapor phase solvents and transmitting megasonic energy through the solvent condensed on the substrate to the matrix (Col. 3, Ins. 27-33; Col. 4, Ins. 41-46). That is, condensate is permitted to exist on the substrate surface for transmitting high frequency sonic energy through the condensate to loosen particles and residues (Col. 11). Any residual solvent remaining is permitted to evaporate after the cleaning process for providing a dry surface (Col. 8, Ins. 3-8). Starov relies upon condensate or liquid to remain on the surface for the sonic energy to be used.

Rose discloses that recirculation and reuse of liquid chemicals is a potential problem (Col. 1, Ins. 42-47). Rose also discloses that there is a move away from current liquid-based cleaning technologies (Col. 1, In. 65 to Col. 2, In. 4).

There is however no disclosure in Starov of the claim 1 element and the cryogenic cleaning as called for in amended claim 1. There is similarly no disclosure of the claim 1 element in Rose. However, the Office alleges that it would be obvious to combine Starov with Rose to arrive at the invention of for example claim 1 herein. But why would Starov which relies upon liquid being present at the substrate surface in order to transmit sonic energy, seek out other references for combination if such other references teach away from having the

liquid at the surface such as Rose does? MPEP 2143.01 (VI) states that "[i]f the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious. In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959)." MPEP at 2100-141. Since Starov teaches that liquid at the surface is necessary in order to employ the sonic energy to the material to clean and remove same, relying upon the disclosure of Rose would remove the very liquid necessary for Starov to operate. MPEP 2143.01 (V) further states that "[i]f proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)." MPEP at 2100-140. Therefore, it respectfully is submitted that these two references are not properly combined.

Accordingly, it respectfully is submitted that amended independent claim 1 and the claims which depend therefrom are not obvious and therefore are patentably distinct from the combination of references set forth in the Office Action at paragraph 13.

The following remarks are presented to address the rejection of the claims under 35 USC §103(a) in the Office Action at page 9, paragraph 15.

Verhaverbeke is directed to rinsing in a single wafer cleaning process, wherein cleaning chemicals and rinsing water such as DI-H₂O are fed through a nozzle to generate a spray of droplets which form a liquid coating on a top surface of a wafer while the wafer is spun at high rotation rates (P. 1 [0015], P. 2 [0020]), such as a rate between 500-1000 and 50-100 rpm, depending upon the wafer (P. 2 [0023]). Spinning of the single wafer is disclosed to be at very high speeds as

shown by the water coating profile on the wafer as it spins at such rate (P. 2, [0023], FIG. 2a). The DI water rinse may be followed with an IPA rinse (P. 3 [0024]) or one may blow the vapor of a low surface tension solution into the center of the wafer which will "have the effect of reducing the bulge...[of liquid]" (P. 3 [0025]). To the extent that gas, such as nitrogen, is used, such use is to effect the "bulge" of liquid, not to effect cleaning of the wafer surface.

Verhaverbeke is directed to rinsing and also teaches that acoustic or sonic waves can be provided to the substrate to travel through the plate water filled gap to improve diffusion of the DI water on the wafer (P. 3 [0028]). There is however no disclosure in Verhaverbeke of the claim 1 element as called for in amended claim 1.

It respectfully is submitted that one skilled in the art would not trial and error to seek out the "optimum or workable ranges" as set forth in the Office Action. The particulars of amended independent claim 1 provide for a close tolerance of use for the fluid that is selected and applied to the substrate surface. That is, the liquid of amended claim 1 must not be applied at a thickness too small or for a period of time too long that such would severely impact the cryogenic cleaning step of the claimed invention. Evaporation occurs prior to the substrate surface cleaning.

Referencing the MPEP sections above and related case law cited, there would be no incentive to combine Verhaverbeke with Rose to arrive at the invention of amended claim 1. That is, Verhaverbeke, teaching to use DI water and IPA to rinse a wafer that has been cleaned, would not look to subject that wet chemical surface to a cryogen stream as called for in amended claim 1, as such action would crystallize the fluid and defeat the very purpose of the spin rinse to remove the liquid from the wafer surface. Additionally, Verhaverbeke does not disclose to evaporate the liquid because the cleaning in Verhaverbeke has already been

completed. Verhaverbeke is interested in rinsing the cleaned wafer surface, so evaporation and cryogen cleaning are of no concern to its process. Indeed, because Verhaverbeke does not concern itself with the surface having the liquid evaporated prior to use of a nitrogen gas for instance, it respectfully is submitted one skilled in the art would not seek to subject the surface to cryogen activity. Further, Verhaverbeke teaches that acoustic/sonic waves may be used in the liquid to help diffuse same, not clean the wafer. This further supports the position that there would be no reason to seek our Rose to modify Verhaverbeke to make the combination purported in the Office Action.

Even if the alleged combination were to occur, and only for the sake of argument, it respectfully is submitted that the resulting combination would still not arrive at the invention of amended claim 1 having the claim 1 element. That is, combining Verhaverbeke with Rose would teach applying a frozen particle aerosol to a wafer surface being spun at a high rate to remove a bulge of rinsing liquid thereon. That is not what is being claimed in amended claim 1 and the claims which depend therefrom. Therefore, it respectfully is submitted that amended claim 1 and the claims which depend therefrom are not obvious in view of and are patentably distinct over the combination of Verhaverbeke in view of Rose.

As claims 8 and 9 ultimately depend from amended claim 1, the arguments above with respect to Rose are repeated such that the rejection set forth in the Office Action at paragraph 11 should be withdrawn. Such action is respectfully requested.

The following remarks are presented to address the rejections at paragraphs 12, 14 and 16 of the Office Action. Such rejections are under 35 USC Section 103(a), are directed to dependent claim 10 only, and rely upon Kuyel as a secondary reference in said rejections. Claim 10 is directed to the size of the

contaminants. It respectfully is submitted that the remarks above with respect to Rose, Starov and Verhaverbeke sufficiently distinguish the patentably distinct amended independent claim 1 from these three references, whether the references are considered alone or in combination with each, such that introducing Kuyel to make a rejection of claim 10 does not arrive at the invention of amended claim 1. The disclosure of Kuyel does not fill the voids of the Rose, Starov and Verhaverbke references to arrive at the subject matter of amended claim 1. Therefore, it respectfully is submitted that claim 10, in view of its dependence upon amended claim 1, is not obvious in view of and is patentably distinct from Kuyel alone or in the combinations set forth in the Office Action.

All issues raised in the Office Action are believed to have been addressed. In view of the foregoing amendments and remarks, favorable action on the merits, including entry of all amendments and allowance of all claims pending, respectfully is requested.

The Examiner is invited to contact the undersigned by telephone to resolve any outstanding issues fro allowance of the present application.

Respectfully submitted,

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Date: November 7, 2008